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AUTHOR Noori, Kathryn K.
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ABSTRACT

For years, tests have been designed to reflect the positivistic-quantitative paradigm and have been developed to ensure that children are learning the "basics." Today, a new method is emerging that utilizes assessment as an instructional tool rather than a measurement tool. Through the use of this new authentic assessment, students are allowed to demonstrate their knowledge in a variety of ways. Included in this document are summaries of various assessment strategies used to review students' understandings of science concepts in the elementary school. Excerpts from students' completed assignments are provided to aid in illustrating the use of the various assessment tools being used today. (ZWH)

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Authentic Assessment in Elementary Science

Kathryn K. Noori

Department of Curriculum, Instruction, & Administration

Tuskegee University, Tuskegee, Alabama

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AUTHENTIC ASSESSMENT IN ELEMENTARY SCIENCE

For years tests have been designed to reflect the postivisitic-quantitative paradigm and have been developed to ensure that children are learning the "basics." Such tests reflect a curriculum which focuses on disparate facts and isolated skills with little attention given to helping students relate their prior knowledge to instruction. These tests are designed to be given to large numbers of students, are centrally mandated, composed of multiple-choice items, and scored by machine (Cole,1991).

As this paradigm gained currency, testing became a high-stakes enterprise and teachers and school districts were held accountable for childrens' scores on tests. The educated learner was viewed as a product and students were assessed for deficiencies and then drilled until skilled (Hay, 1984). Schools influenced by this movement were organized like factories with the purpose of turning out people who did not have to think. Likewise teachers had no autonomy and were not required to think independently or allowed to make their own authentic decisions.

Educators have began to recognize the impact of testing on curriculum and that assessment can act as a lever in bringing about positive and constructive change in the educational system. When tests are viewed as instructional tools and part of the educational system, they become effective in promoting good instruction and learning. (Cole, 1991). Because teachers tend to "teach to the test" by reforming the present testing system, teachers will test to the "big ideas" and major concepts rather than peripheral topics. (Baron, 1991)

New assessment strategies that are considered as instructional tools rather than measurement tools are referred to as authentic assessment or performance assessment. These strategies support and compliment the constructivist view of education that learning is personally constructed and that learning depends on the intentions, self-monitoring, elaboration, and representational construction of the individual learner (Resnick, 1989). Authentic assessment techniques are not viewed in isolation from instruction but rather are woven into the curriuclum and occur when teachers genuinely engage children in intellectual challenges. These techniques or authentic assessment strategies offer teachers a window into the minds of students allowing teachers to focus and build instruction on the prior epistemology that students bring with them to the class setting. Authentic assessment strategies allow children to demonstrate their knowledge in a variety of ways including portfolios, journals, graphs, drama, poetry, and concept webbing.

A Survey of Authentic Assessment Strategies

Following is a summary of various assessment strategies that this writer believes are meaningful and appropriate for assessing science concepts in the elementary school. These methods are illustrated with hypothetical examples when appropriate.

Dialogue

Teachers set the stage for authentic assessment by creating environments that encourage constructive dialogue. Children learn by discussing, talking, and sharing ideas and teachers gain insight into childrens' thinking by listening to their conversations. By focusing instruction on childrens' prior knowledge and conceptions, teachers help children make new connections and move on to new challenges. (Duckworth, 1987).

Journals

When used during science, journals help students make personal connections, provide a place for students to express their thoughts and record observations, and provide an alternative approach to traditional testing. Tippins and Dana (1992) have suggested using journals as a pretest to gain initial understanding of childrens' knowledge of a concept. For example, at the beginning of a unit students may be asked to write in their journals what they know about a particular topic. Teachers can then use this information for instructional purposes. As students continue to record their thoughts and ideas throughout the study, the journal becomes an important way of monitoring students' ideas and growth. For example, in responding to the statement, "Tell me what you know about insects" Heather, a 7-year-old wrote:

I no tot som insekts fl.
and som insekts crol and som
insekts b.t you

After several days of study about insects Heather was able to elaborate on the subject as shown below. While Heather has learned a lot about insects, she still has some incorrect notions.

ther are mone typs of insekts lik butterflis,
flis, muskeetos and cockroaches and spiders.
tha hav 6 legs. the butterfly is the most
butiful. It goes from an egg to a caterpillar,
to a pupa, to a butterfly. Insekts have antenn
and 6 legs.

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After studying about the earthcycles (water cycle, air cycle, and soil cycle) Connie, a 4th grade student, draws a diagram of a water cycle in her journal.

1. Water evaporates into the air. The water comes from rivers, lakes, + oceans. Also, soil and plants.
2. Rain falls from the clouds
3. the rain goes back into the soil and eventually ends up in a river or lake or ocean. Then the cycle starts over.

Recording Observations

Observing is a process skill and an integral part of science. Children should be encouraged to write and illustrate their observations on a regular basis. Encouraging children to communicate their observations provides teachers with yet another view of the child's mind and can serve as springboards for interesting discussions. Written observations can be recorded in many different forms including journal writing, class booklets, poster creations, etc.

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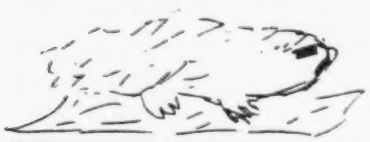
Doris (1991) suggests using a structured "format" for helping children record their observations. Following is an example of an 8-year-old's observation of a guinea pig using the format suggested by Doris.

BLAKE'S observation

date: 7/14/92

I looked at a guinea pig

A picture of what I saw



Here are some things I noticed:

Guinea pigs squeak. They have red eyes. They have four toes on their back feet and three toes on their front feet.

After observing a candle burn, 8-year-old Jason writes the following observations in his science journal:

The candle was white and the flame hot. There was some thing black coming from the candle. The wax melted. Part of the flame was blue and part of the flame was yellow.

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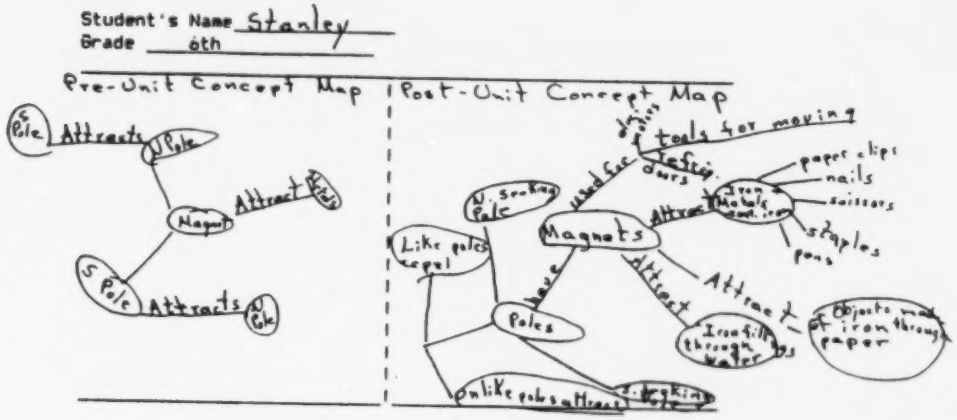
Concept Mapping

Concept mapping is a method of assessment that allows children to organize concepts in a way that is personally meaningful for them (Dana, Lorsbach, Hook, and Briscoe, 1991). Through concept mapping children can connect concepts and show relationships in different ways. Dana et al. (1991) suggests using concept mapping as pre-and post-unit assessments. When used in this manner, concept webbing dramatically documents what students have learned. The example provided below illustrates the use of concept webbing before and after a unit on magnets.



Drama

Kamen (1991) has discussed how children lucidly reveal their knowledge of science concepts through creative drama techniques such as role playing, pantomining, and movement. As teachers observe children enact various science conepts during a science activity, they can use students' current understandings to scaffold or move students from what they know to what they need to know. Creative drama is particularly appropriate for young children as abstract ideas become concrete through children's physical representations. Examples of creative drama follows.

> After allowing her first grade class to "mess around" with magnets, a teacher wants to know if the children understand what objects magnets attract. She identifies two of the children as magnets and gives objects such as plastic pencils, paper clips, wooden pencils, a

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piece of leather, a book, a nail, a pair of scissors, and brass objects to the rest of the children. The children are asked to demonstrate magnetic attraction. The teacher is clearly able to understand whether or not children know which objects are attracted by magnets. Further discussion and experimentation can then focus on magnetic attraction of various objects--particularly metal objects (many children believe that magnets will attract all metals or all shiny objects).

A 4th grade class has been studying about reptiles and the teacher wants to know if his class understands how animals maintain their body temperature. He calls out various names of animals (i.e., birds, cats, dogs, turtles, snakes, lizards) and asks the class to show him how each animal might behave during a chilly day and a sunny day. A discussion follows the activity about how cold-blooded animals maintain favorable body temperatures by behavioral means.

Creative Writing

Many different formats lend themselves to creative writing using science themes including poems, posters, travelogs, news articles, and letters. Creative writing activities often require research skills and promote higher order skills as children must analyze, synthesize, and evaluate information. (Drenkow, 1992)

Two-worded poems are an excellent way to foster creativity. Because the rules are simple, each line has only two words; children can express themselves freely and without inhibition. Following is a poem written by a 2nd grade child after studying about magnets.

A Magnet
Has force
Can attract
Many objects
Such as
Paper clips
Scissors, Silverware
Staples, Nails
Some pens
Plus many
Other objects

Max, a 5th grade student, practiced skills in writing formal letters when he demonstrated his concern for the environment by writing a letter to the Secretary of the Interior and Director of the Environmental Protection Agency:

Max Brown
193 Elm Street
Tuskegee
Alabama 36088

The Honorable Secretary
Environmental Protection Agency
July 15, 1992

Dear Honorable Secretary
I have been learning about the environment and am very concerned about the "garbage" that we throw out everyday. I am particularly concerned about juice boxes. We throw out used juice boxes everyday and they are littering our environments. I believe a law should be passed that would not allow manufacturers to sell juice in paper containers that destroy our natural resources and litter our environment. Please do what you can to help preserve our natural environment.

Yours sincerely,
Max Brown

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Art Activities

While educators generally agree that students' art work is a powerful way of showing how they represent themselves and may be used as a diagnostic tool as a guide to thinking, a recent study conducted by McGrath and Ingham (1992) showed that art related activities could be used as a tool for assessing children's science concepts. By studying childrens' art (painting, drawing, modelling and collage) as it is related to science concepts it is possible to determine children's misconceptions and lack of understanding and use that information in planning for instruction.

During a unit on light children participate in several playground activities including: 1) making big, small, and fat shadows 2) chasing their shadows and 3) standing on the shadows of other children. The position of the sun should be discussed with children during these activities. In the classroom teachers could ask children to paint a picture of a sunny day. Children's misconceptions are addressed through open-ended questions and dialogue. Following is an example of a hypothetical drawing by a 7 year old. (This example is modified from a technique developed by McGrath and Ingham, 1992).

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Graphing Activities and Charts

Graphing develops naturally from activities that involve children in classifying and making comparisons and is an effective tool in helping chidren to see relationships and consolidate and retain information.

Graphs can be used in studying nearly every science topic. One topic frequently studied at many different grade levels is weather. Children can investigate weather trends by looking at the sky to see the type of clouds, the appearance of the sun, and whether or not there is rainfall. Findings can be kept on a daily weather chart:

	Clouds	Wind	Average Rainfall	Rainfall Today
Monday 3/11/92	NO	light S.E.	2½ mms	none
Tuesday 3/12/92	high cirrus	none	2½ mms	none

Another topic frequently studied is "Sink or Float." A group of 7-year- olds made predictions on the graph below as to whether they thought various objects would sink or float.

	Sink	Float
leaf		✓
nail	✓	
balloon		✓
cork		✓
wooden spoon		✓
metal spoon	✓	

After studying about the need for light in the photosynthetic process Paul, a 5th grader, decided to study how light affects plant growth. Paul gave four different plants different hours of light per day (one plant one hour of light per day, another plant two hours of light per day, a third three hours, and a fourth one five hours) and controlled all other variables such as heat and water. He conducted his experiment for several weeks noting the quantity and color of leaves and the mass of the plant. Paul recorded his observations on a chart:

Date	1 hour light	2 hours light	3 hours light	4 hours light
July 6, 1992	green leaves 1 Kilogram	green leaves 1 Kilogram	green leaves 1 Kilogram	green leaves 1 Kilogram
July 13, 1992	leaves turning yellow 1 Kilogram	leaves yellow 1 Kilogram	drooping of plant leaves 1 Kilogram	leaves falling 1 Kilogram
July 20, 1992	brown leaves 1 Kilogram	yellow leaves 1 Kilogram	brown leaves 1 Kilogram	brown leaves 1 Kilogram

Chart is hypothetical data of experiment.

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Portfolios

Portfolios or collections of students' work has become a popular way of demonstrating childrens' growth over a period of time. While portfolios can be varied, a purposeful collection contains exhibits that reflect the student's efforts and progress. Products of any of the assessment strategies discussed in this paper could constitute meaningful exhibits for a child's portfolio.

Children should be active participants in making judgments in selecting the pieces for a portfolio and be encouraged to include information that demonstrates self-reflection. (Paulson, Paulson, & Meyer, 1991). For example a student might write a statement telling about what he has learned:

I feel good about what I have learned this year in science. I know many new things such as the behavior of snails and squids, solar energy and levers. Science is fun for me.

In helping children reflect on their work Herbert (1992) suggests holding individual conferences with students and asking questions similar to the following:

--What do you know about science that you didn't know last year?
--What is unique about your portfolio?
--What would you like your parents to understand about your portfolio?

Portfolio evenings provide opportunities for children to share their portfolios with their parents. Children feel a sense of pride and accomplishment as they talk about their work and parents have a concrete picture of what their child has learned.

The strategies discussed in this paper represent a valid and meaningful way of informing parents and subsequent teachers of a child's progress.

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